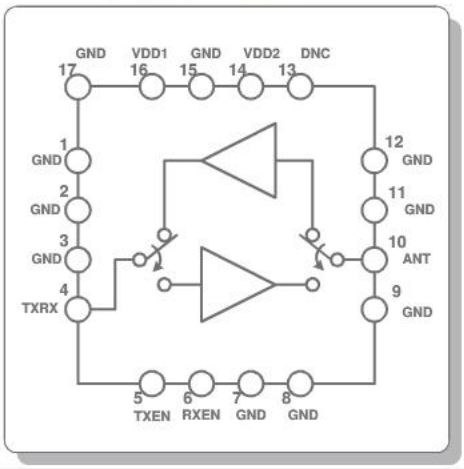
RFX2401C Single-Chip CMOS RFeIC with PA, LNA, Antenna Switch and Combined Tx/Rx Transceiver Port

Eval Board Test Summary & Application Notes

RFX2401C RFeIC Key Features and Benefits

(3x3x0.5mm
16L QFN)



RFX2401C Differentiating Features

- Integration of PA, LNA, Tx-Rx Switching Circuitry, Associated Matching Network, Harmonic Filter, and PA Power Detection Circuit all into a Single-Chip, Single-Die pure CMOS Solution
- Greatly Reduced and Simplified Tx/Rx Control
- Low Voltage Battery Operation down to 2.0V
- Digital Logic with 1.2V Turn-On Voltage
- No Vref Regulator for Biasing
- Common Tx/Rx Port Saves Additional SPDT
- Requires Minimal External Components
- Small, Ultra-Thin 3x3x0.45mm 16L QFN Package

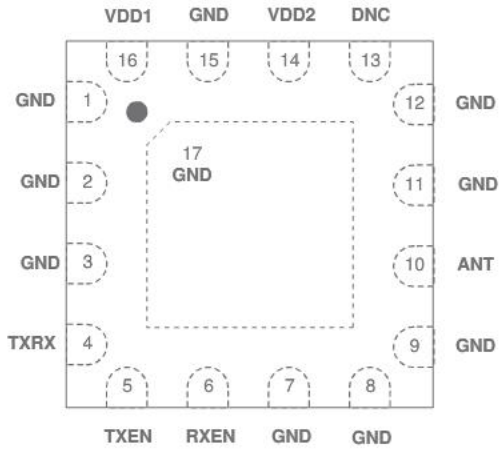
APPLICATIONS

- 802.15.4 ZigBee Extended Range Devices
- ZigBee Smart Power
- ZigBee Home Area Network
- RF4CE Remote Control
- Wireless Sensor Networks
- Other 2.4GHz ISM Band Systems

RFX2401C Customer Benefits

- Greatly Simplified, 50 Ohm “Plug & Play” PCB Implementation
- Small Form-Factor and Quick Design Cycle
- Simplest Approach to Improve Link Performance including Range and Receiver Sensitivity
- Very Low BOM Cost and Competitive Price

RFX2401C Package Pin-Out and Pin Description

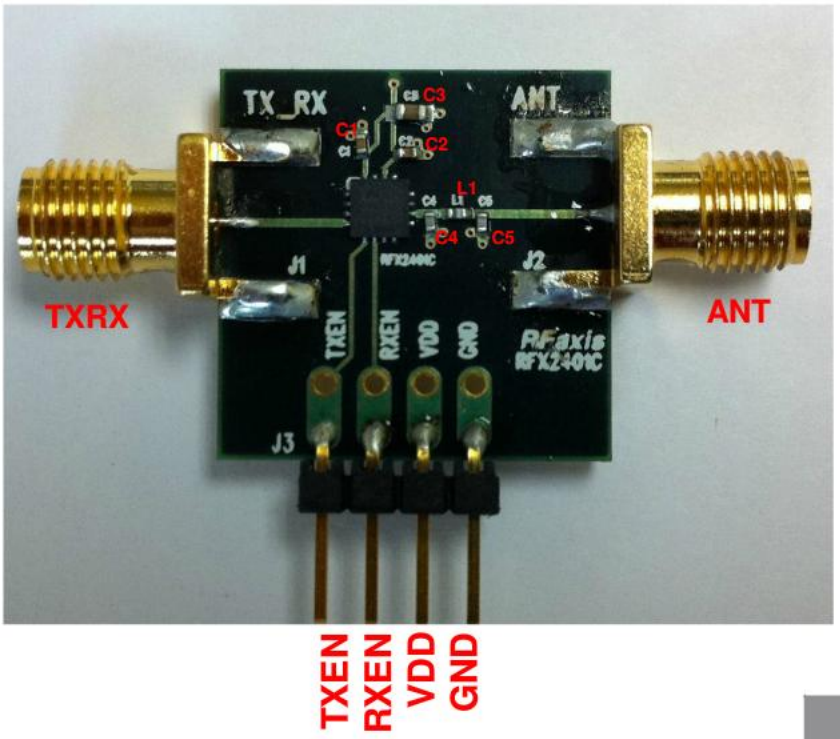


(Top "See-Through" View)

Pin Number	Pin Name	Description
4	TXRX	RF signal to/from the Transceiver: DC shorted to GND
5	TXEN	CMOS Input to Control TX Enable
6	RXEN	CMOS Input to Control RX Enable
10	ANT	RF Signal from the PA or RF Signal Applied to the LNA; DC Shorted to GND
1, 2, 3, 7, 8, 9, 11, 12, 15, 17	GND	Ground – Must be connected to Ground in the Application Circuit
13	DNC	Reserved – Do Not Connect in the Application Circuit
14	VDD2	Voltage Supply Connection for the PA
16	VDD1	Voltage Supply Connection for the LNA

RFX2401C Eval Board and Preliminary BOM

Preliminary BOM:



For VDD decoupling:
C1=10nF (for VDD1, pin 16)
C2=220pF (for VDD2, pin 14)
C3=2.2uF (for both VDD pins)
C4=C5=2pF
L1=1.5nH TDK part # MLG1005S1N5CT000

DC Bias & Tx/Rx Logic Control:

VDD=3.3V Nominal (1.8~3.6V Operational)

For Transmit Mode (Tx):
- TXEN=High (>1.2V)
- RXEN= Don't Care

For Receive Mode (Rx):
- RXEN=High(>1.2V)
- TXEN=Low (<0.3V)

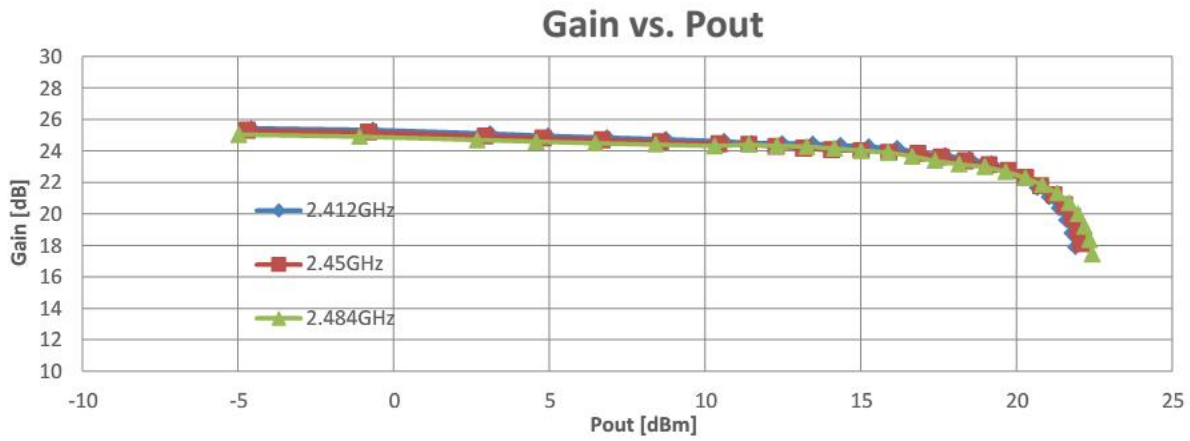
Control Logic Truth Table

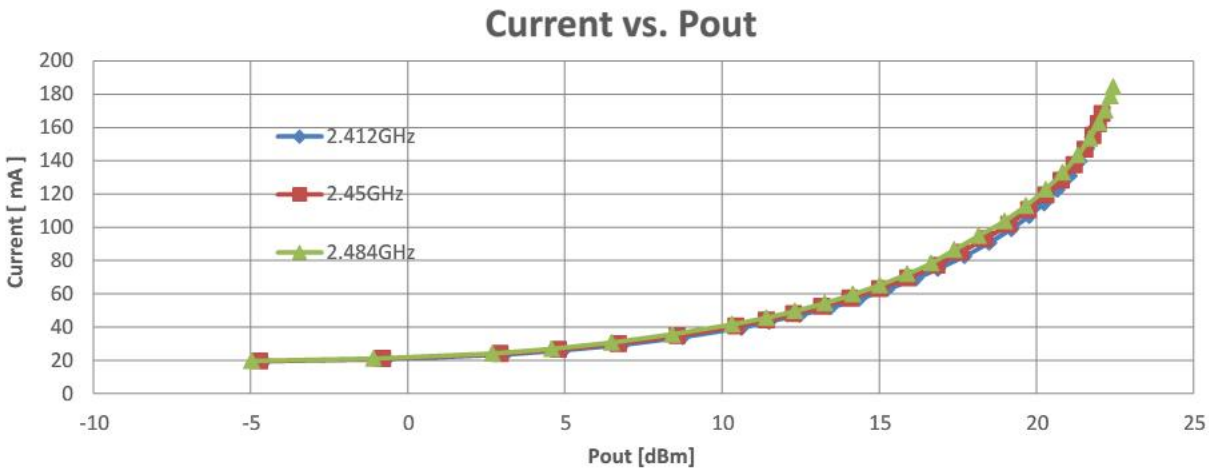
TXEN	RXEN	Operating Conditions
1	X	TX Active
0	1	RX Active
0	0	Chip is Shut-down

Eval PCB Information:

- 4-Layer Stack, 10mil/40mil/10mil
- FR4 with εr=4.5, tan δ = 0.02 (Typ.)

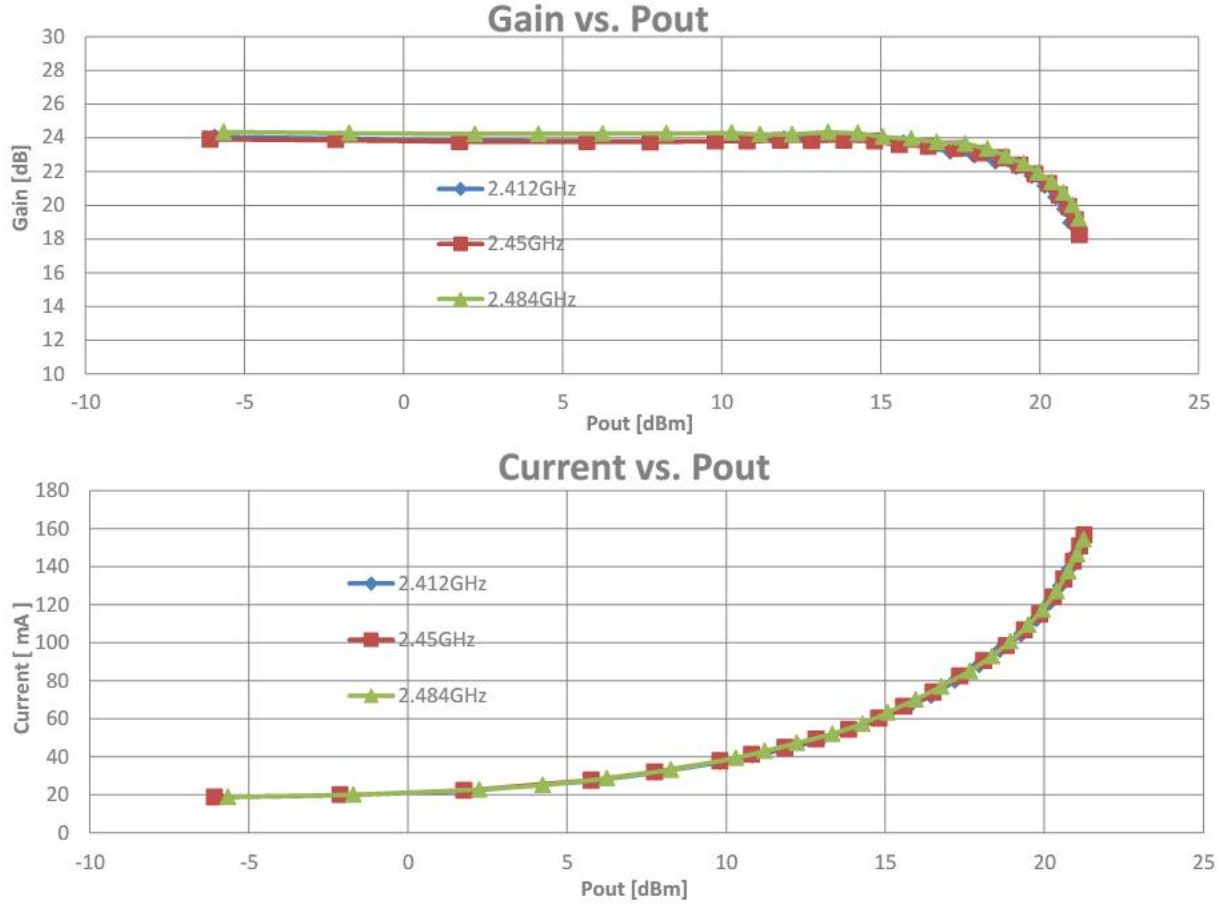
Tx CW Gain and Current vs Pout & Frequency (VDD=3.3V)





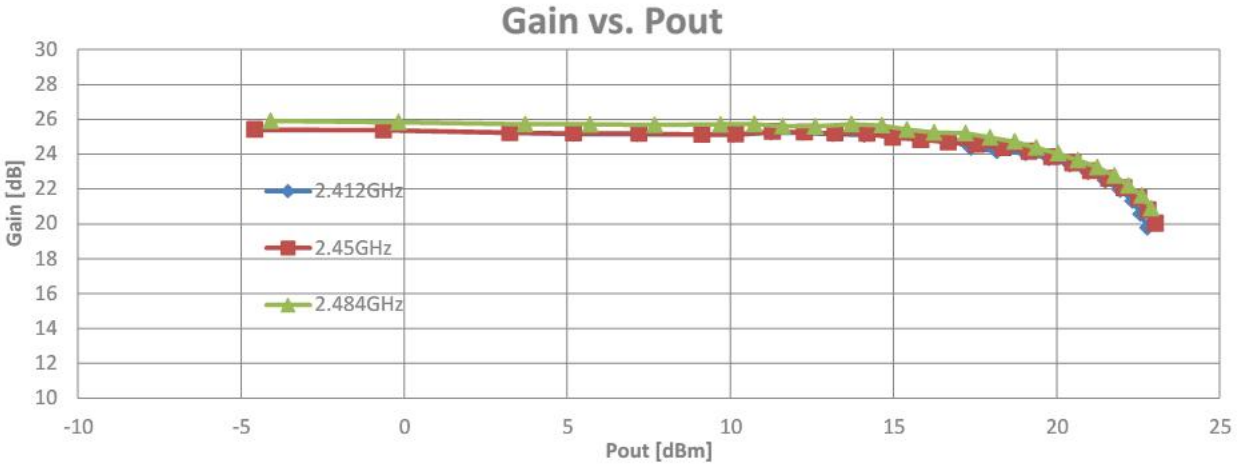
Note: Output power measured at antenna, after the harmonic filter which has ~0.5dB insertion loss.

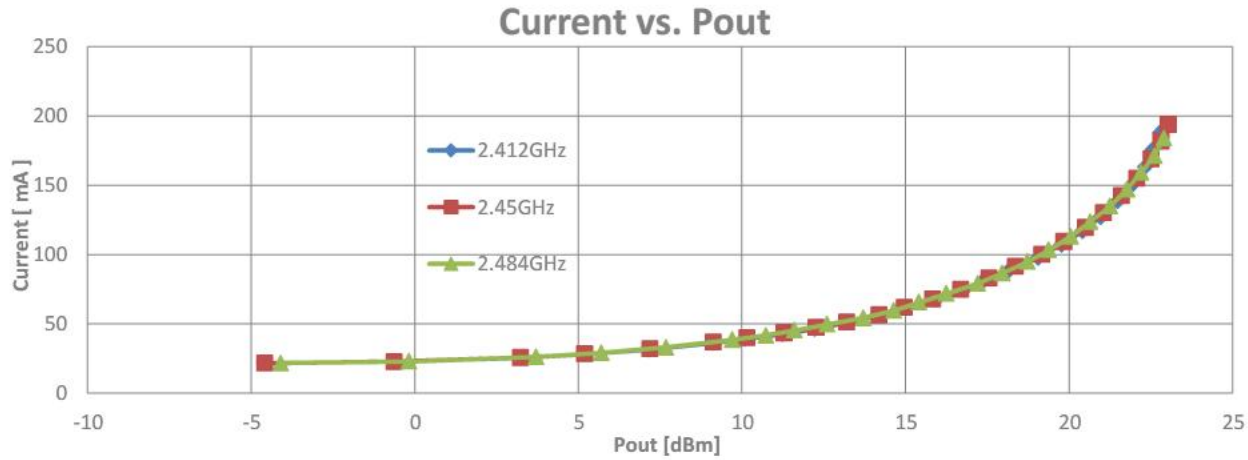
Tx CW Gain and Current vs Pout & Frequency (VDD=3.0V)



Note: Output power measured at antenna, after the harmonic filter which has ~0.5dB insertion loss.

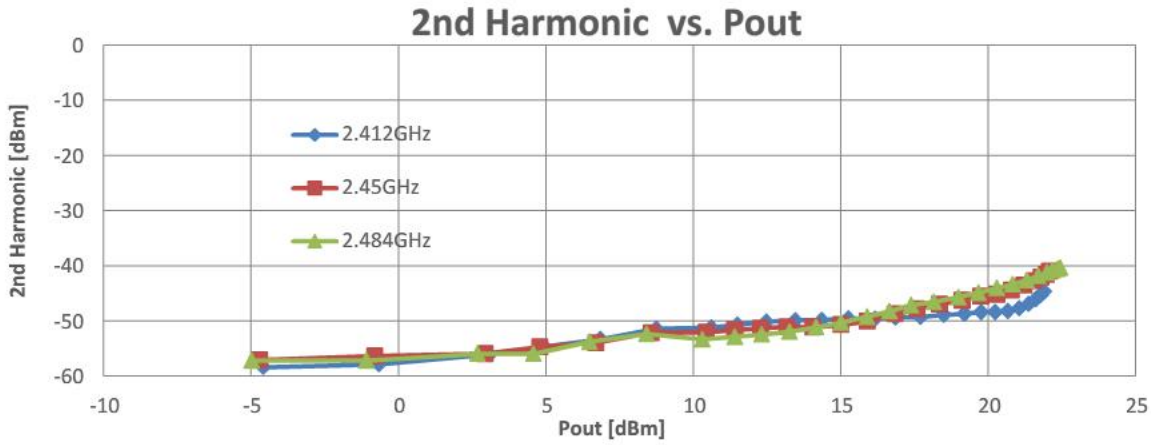
Tx CW Gain and Current vs Pout & Frequency (VDD=3.6V)

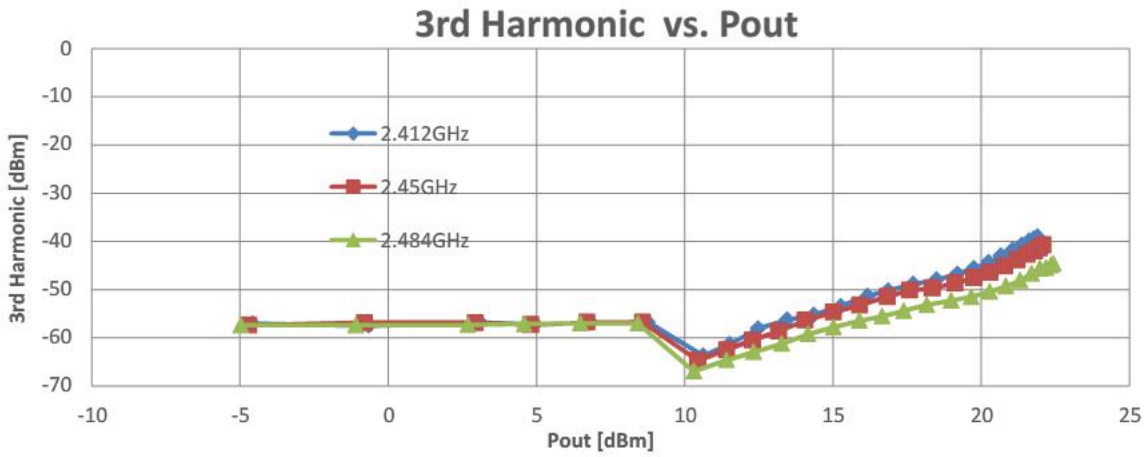




Note: Output power measured at antenna, after the harmonic filter which has ~0.5dB insertion loss.

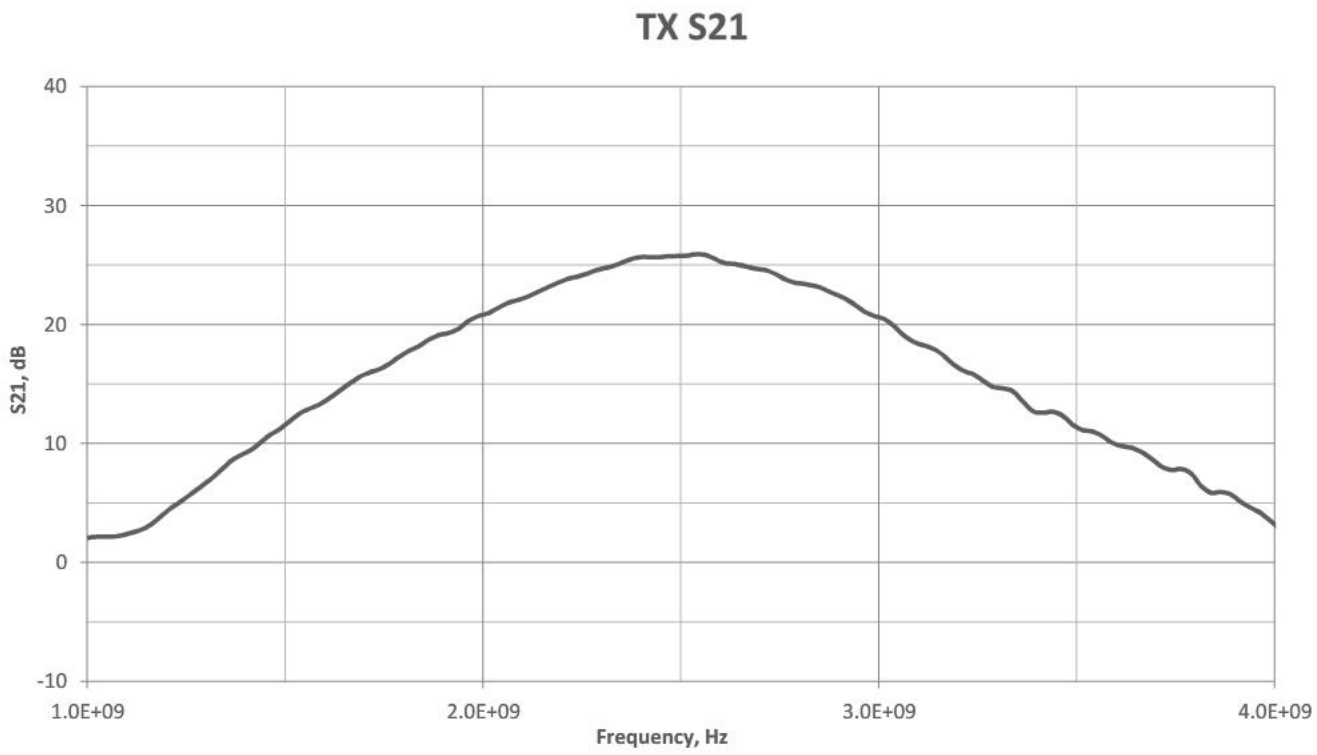
Tx Harmonics vs Pout & Frequency (VDD=3.3V)



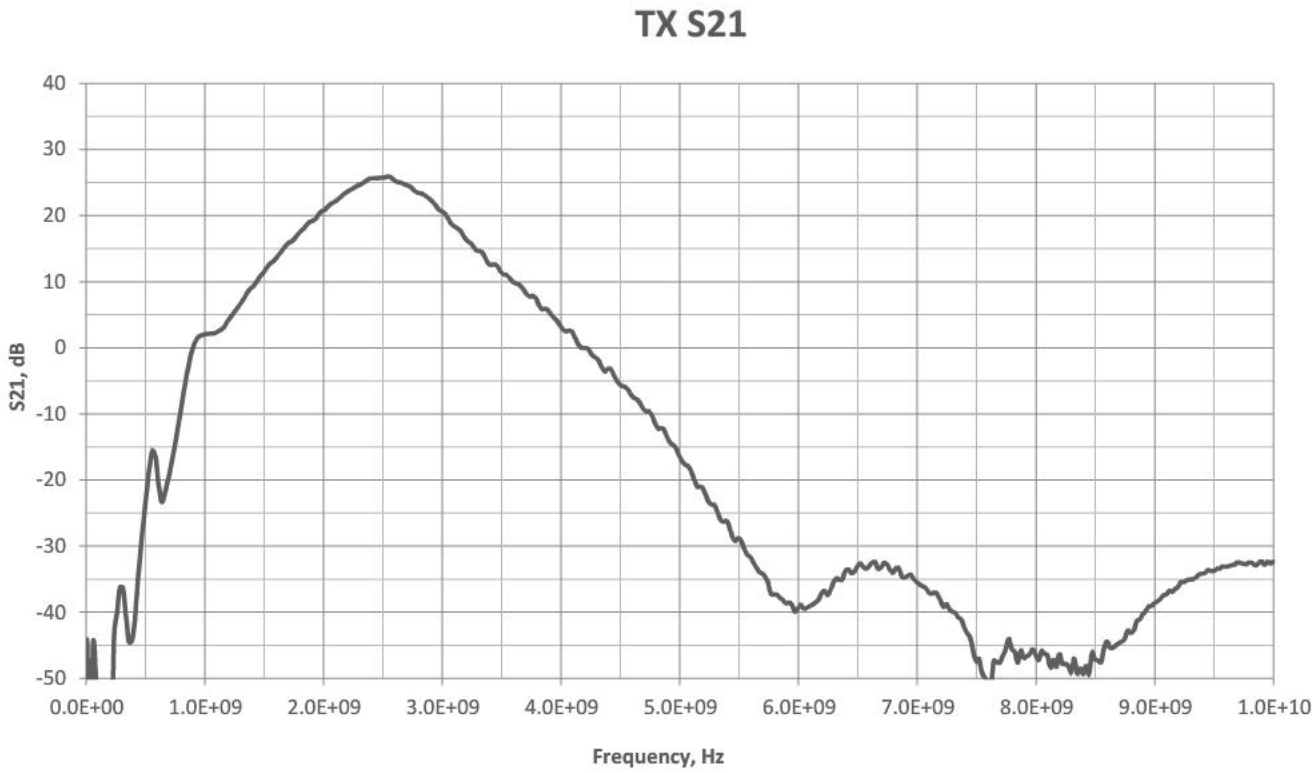


Note: RFX2401C can achieve FCC harmonic compliance with only one simple pi-filter.

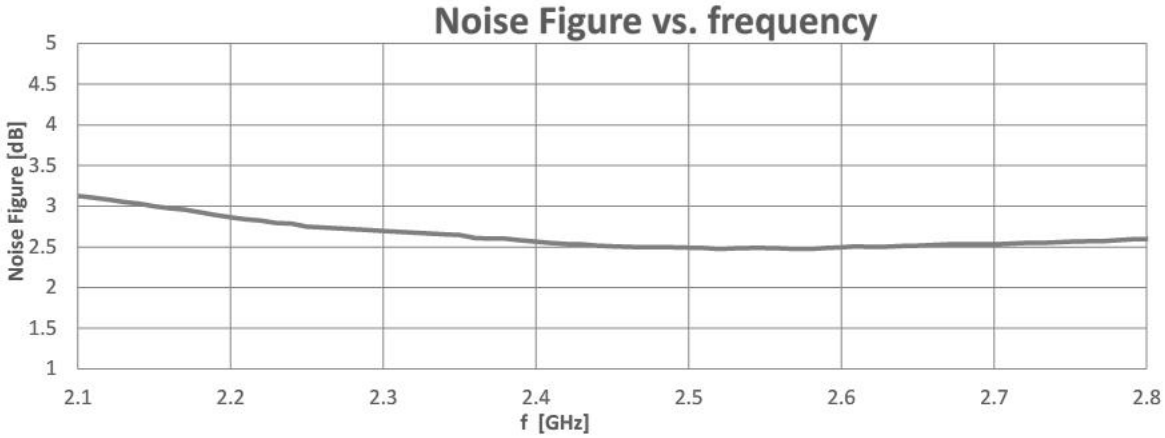
Measured Tx Small-Signal Gain (S21) (VDD=3.3V)

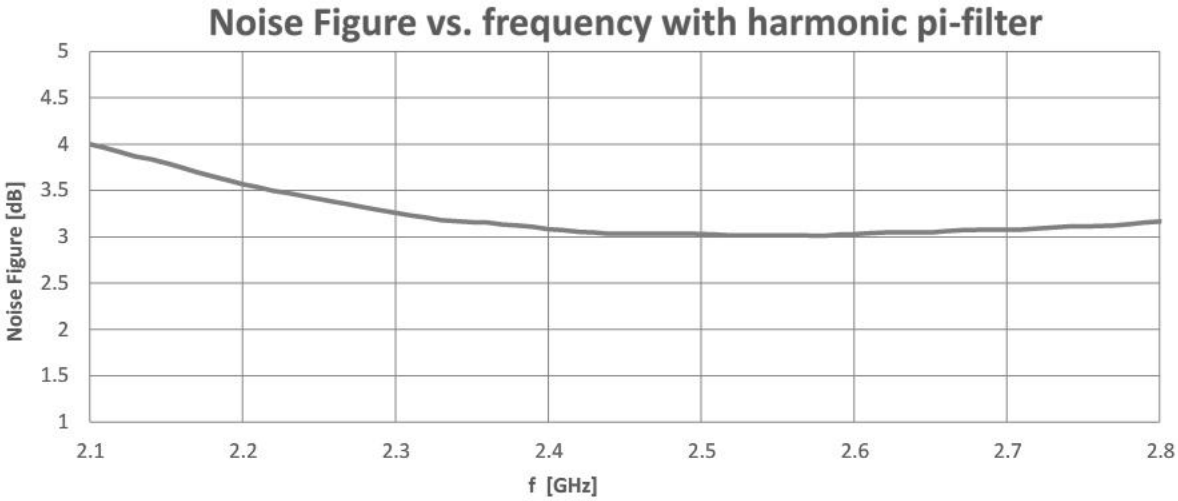


Measured Tx Wideband Small-Signal S21 (VDD=3.3V

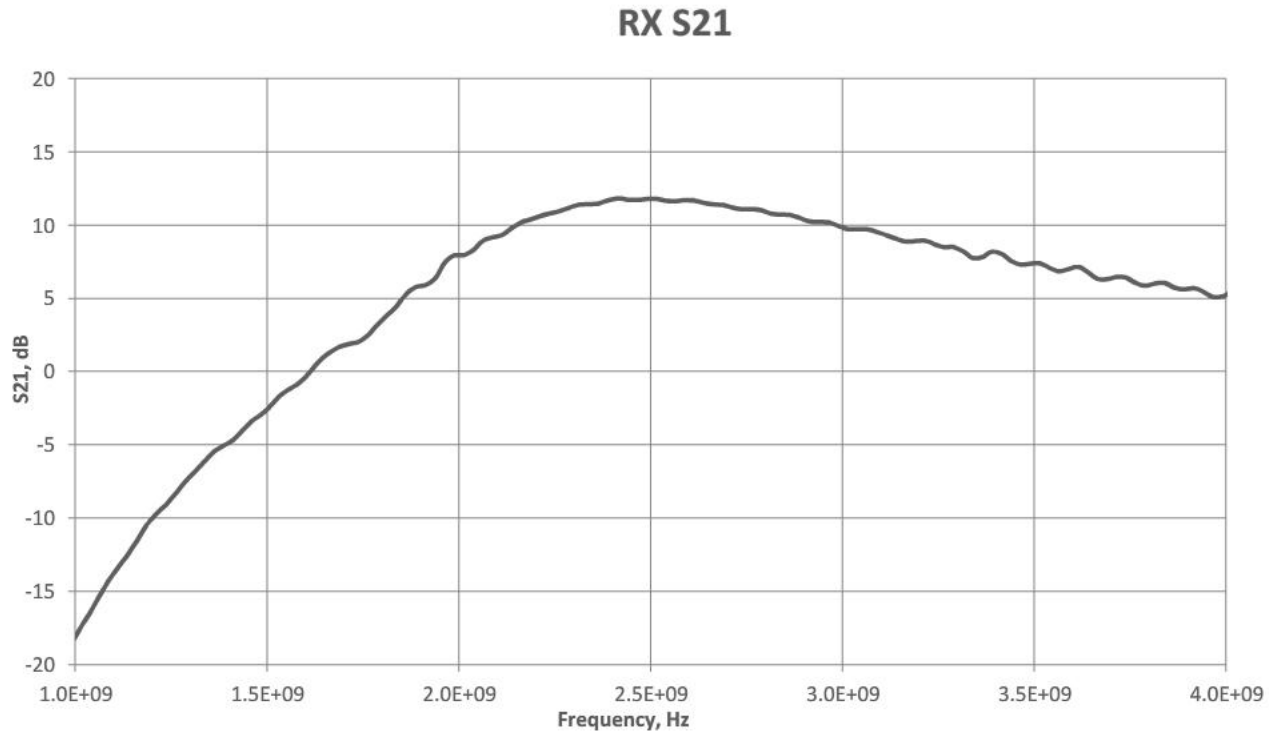


Measured Rx Noise Figure (VDD=3.3V)



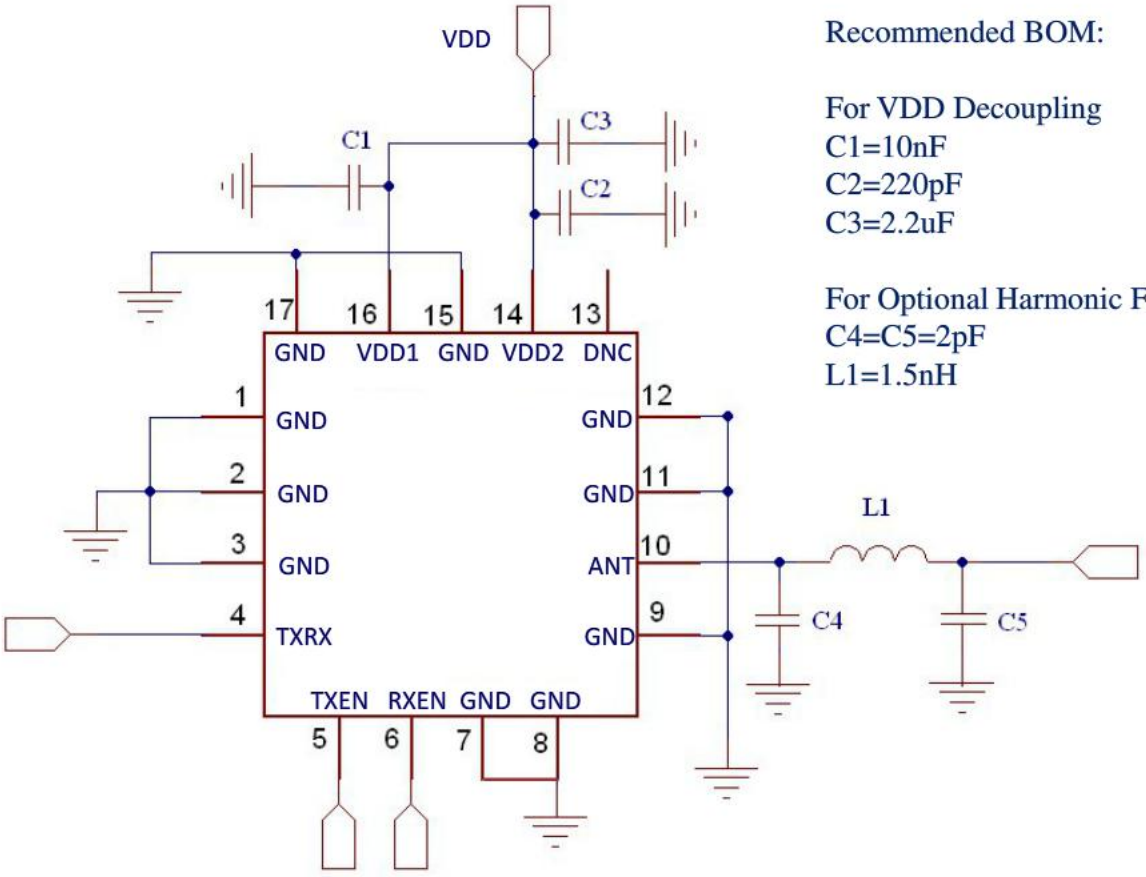


Measured Rx Small-Signal Gain (S21) (VDD=3.3V)



RFX2401C Application Schematic & BOM

Typical Application Schematic

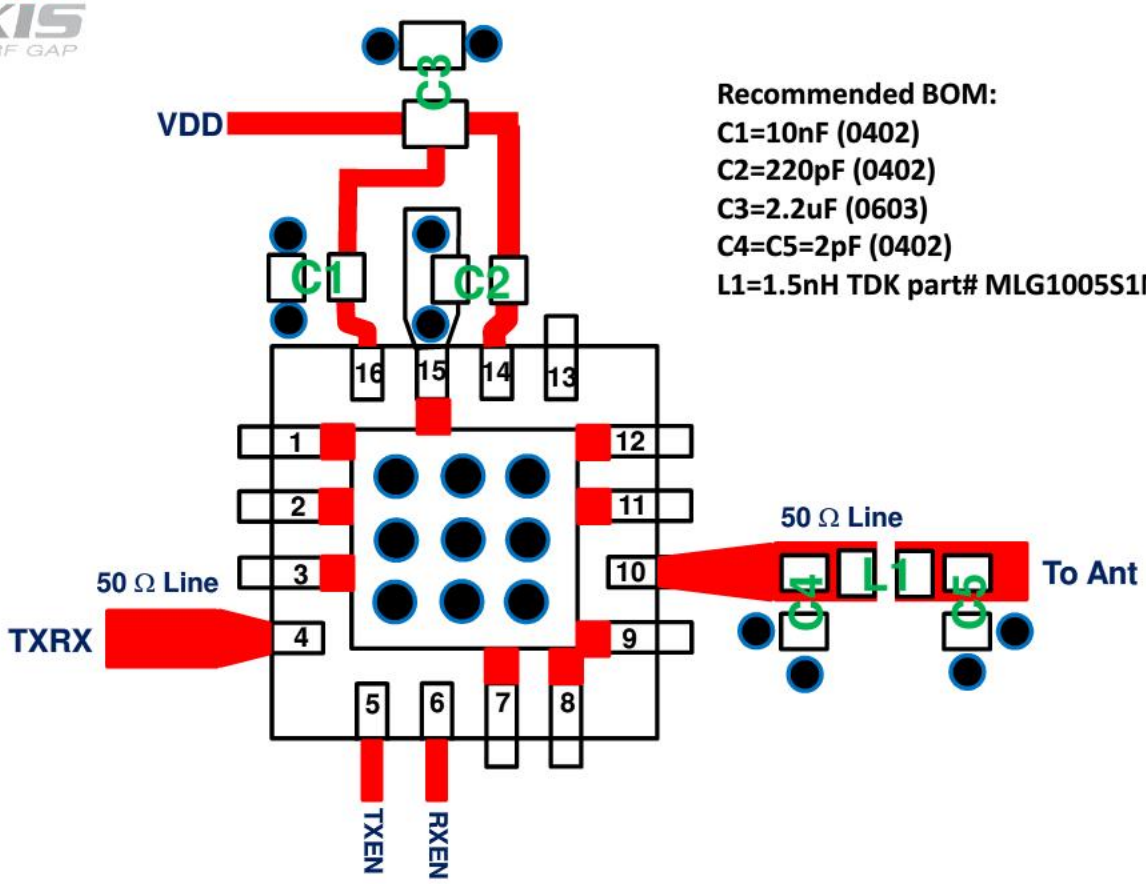


Recommended BOM:

For VDD Decoupling
C1=10nF
C2=220pF
C3=2.2uF

For Optional Harmonic Filter
C4=C5=2pF
L1=1.5nH

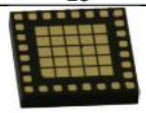
RFX2401C PCB Layout Recommendation



Recommended BOM:
C1=10nF (0402)
C2=220pF (0402)
C3=2.2uF (0603)
C4=C5=2pF (0402)
L1=1.5nH TDK part# MLG1005S1N5CT000

Notes:
-Tie all unused pins to center ground paddle
-For best RF performance please place 9 vias under the center ground paddle
-Place two vias immediately next to each shunt cap (C1,C2,C3, C4, C5) if possible

RFX2401C Competitive Analysis

Vendor		RFaxis	TI	TI	SiGe	Atmel	NEC/Renesas	UBEC	Maxi-AMP	Skyworks	Skyworks
P/N		RFX2401C	CC2590	CC2591	SE2431L	T7024	uPG2253T6S	UP2268	MCP03	SKY65336	SKY65352
	Process	Pure CMOS	SiGe BiCMOS	SiGe BiCMOS	SiGe BiCMOS	SiGe BiCMOS	GaAs FET	GaAs	GaAs	GaAs	GaAs
	Package Size	3x3x0.5	4x4x0.9	4x4x0.9	3x4x0.9	5x5x0.9	3x3x0.75	3x3x0.6	4x4x0.75	8x8x1.3	6x6x1.3
	Package Pin Count	16	16	16	24	20	16	16	20	28	20
	Package Image										
	Nominal Vcc(V)	3.3	3.0	3.0	3.0	3.0	3.0	3.3	3.3	3.0	3.3
Tx	Icq(mA)	17	8	40	30	125	36	9		50	70
Tx	Gain(dB)	25	14	22	24	30	19	11	22	17	20
Tx	Psat(dBm)	22	13.8	20.6	20.0	23	20	15 P1dB	19.1 P1dB	20	21
Tx	Current (mA)@Pout	100@20	22@12.2	112@20.6	120@20	165@23	90@19	23@14	65	145@20	110@20
Rx	Gain(dB)	12	11.4	11.0	12.5	16	No LNA	17	12	10.5	10
Rx	NF(dBm)	2.4	4.6	4.8	2	2.1		2.3	2.6	2	2
Rx	Icq(mA)	10	3.4	3.4	5	8		6.5	7	8	7
Rx	Input P1dB(dBm)	-8	-21	-17	-8	-22		-6		-11	N/A